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Response of Sugar Beet Grown in Newly Reclaimed Soil to Different Nitrogen Sources at Different Growth Stages

[1]Kamal, K. Attia and [2]Yasser. A. M. M. Khalifa

[1]*Soil and water Department, Faculty of Agriculture, Assiut University. Egypt.*
[2]*Agronomy Department, Faculty of Agriculture. Al –Azhar University. Egypt.*

ABSTRACT

This study was conducted at El – Ghorieb Agriculture Research Station, Faculty of Agriculture , Assiut university, Egypt during two successive of 2010/2011and 2011/2012 to investigate the effect on nitrogen source of nitrogen (ammonium sulphate (20%) , ammonium nitrate (33.5%) and urea (46%) at rate of 90 kg N / fed .at four growth stages namely 100,130,160 and 190 days from sowing growth yield and quality as well as some nutrient content of sugar beet are grown under newly reclaimed condition , sandy non calcareous soil , located in eastern desert of Assiut governorate in the entrance of Wadi Assiuty. Also, the concentration and up take of some nutrients in the tops and roots of sugar beet was also studies. The obtained results showed that nitrogen application as ammonium nitrate increased fresh root, shoots and sugar. Also, the beneficial effect of ammonium nitrate was obtained on sugar beet growth criteria such as fresh and dry weight of shoot and roots as well as some chemical composition and quality percentages TSS, Sucrose , Purity and nutrient up take there was significant differences between N sources in their effect on growth, yield quality and quantity as well as nutrient up take of sugar beet . In most growth stage application of N fertilizer, in form of ammonium nitrate was superior affected followed by ammonium sulphate, then urea. There was significant influences for N sources on the % of N, K, and Na whether in top or in root in most cases at different growth stages. Up take of N, K, Na, B and Zn (in most cases) in sugar beet root was significantly affected by N source; The percentage of TSS, and Sucrose were improved as grown season progressive as general application ammonium nitrate mostly improved juice quality at the different growth stages of the two seasons.

Key words: Sugar beet, nitrogen, sources, reclaimed, Egypt

Introduction

Sugar beet (*Beta Vulgar is* L.) represents one – third of word sugar production (FAO, 2007). In Egypt, sugar beet is second crop sugar production after sugar cane. The cultivated area in 2006/2007 seasons was 248210 fed. Produced about 721825 ton of sugar fed .(ISO2007)the important of this crop comes its ability to grow in newly reclaimed soil and provides growers under low soil fertilizer profitable incomes .fertilization is one of most important limiting factors for sugar beet production under Egyptian condition. Recently, sugar beet crop has been an important position in Egyptian crop rotation as winter crop not only in fertile soil but also in poor, saline, alkaline and calcareous soils.

It could be economically grown in newly reclaimed. It is known that soils of reclaimed soils are poor in nitrogen as well as micronutrients and phosphorus are fixed and their available amount are not sufficient for sugar beet to yield .so , application of more available nitrogen are need to maximize the sugar beet yield and it quality .

Nitrogen has by far the greatest influence on quality and sucrose production through its role in stimulating the meristematic growth activity which contributes to the increase in number of cells in addition to cell enlargement and consequently increase growth and development of all living tissue however, over fertilization with nitrogen can increase impurities, root and top yield reducing sugar percentage and quality. the strategic of sugar production to expand sugar beet cultivation in newly reclaimed land where some soil properties, especially salinity pH,$CaCo_3$ content high sand content , poor in organic matter content . Newly reclaimed land nutrition problems, should be considered especially nitrogen owing to low availability of nitrogen fertilizers under the arid and semi-arid region. The influence of nitrogen fertilizer sources on agronomic efficiency is mainly due to their effect on soil reaction and nutrients availability (Stecker *et al.*, 1993). Many investigators in Egypt reported that urea gave the highest root and sugar yields followed by ammonium sulphate and then ammonium nitrate (Saif, 1991). Zalat (1993) found that nitrogen fertilizer in the form of calcium nitrate gave the highest leaf area per plant, root and top yields per Feddan followed by ammonium sulphate than using urea as nitrogen source. Moreover, Nemeat Alla (1997) and (2001) reported that ammonium nitrate as a nitrogen fertilizer source surpassed other nitrogen fertilizer sources *i.e.* urea or

Corresponding Author: Yasser A. M. M. Khalifa, Department of Agronomy, The Faculty of Agriculture, AL azhar University, Egypt.
E-mail: yasserbeet @yhoo.com - yamohame@uark.edu

ammonium sulphate and produced the highest values of root length and diameter, root and top fresh weight (kg/plant), root, top and sugar yields (t/Fed) as well as TSS percentage. (Chaillou and Lamaze, 1997, Britto and Kronzucker, 2002). Some researchers have reported that urea is less efficient than other forms of N for plant growth and yield. Savvas *et al*., 2006). Changes in the pH of rooting zone could greatly influence the uptake of micronutrients and thus causing the nutritional imbalance in plants.

Material and Methods

During two winter seasons in Egypt 2010/2011 and 2011/ 2012 afield trials wear carried out el – ghorieb agriculture research station, faculty of agriculture, Assiut University, Egypt. in order to investigation the effect of the source of nitrogen fertilization (three sources namely ammonium sulphate (20%N),ammonium nitrate (33.5%N)and urea (46%N) at rate of 90kg per fad on growth, yield ,chemical composition and quality control of sugar beet. Phosphorus and potassium fertilizers was applied as calcium superphosphate (15.5%p_2o) and potassium sulphate (48%k_2o) at rate of 31 kg p_2o/fed and 48%k_2o /fed respectively. The soil fertilized with calcium superphosphate during soil preparation, while potassium fertilizer was applied after thinning. Plots were arranged in complete randomized block design with three replications the experimental unit content sex rows of seven meters in length and 50 cm in width some physical and chemical properties of the experimental soil were determined before sowing and presented in table (1), according to the methods described by Jack son (1967). Seed ball of multi – germ Kawemira cv were sown in hills 20 cm apart at rate of 2-3 balls / hill plant were thinned to one plant per hill at 4-6 leaf stage.

Table 1: Some physical and chemical properties of representative soil samples in experimental before sowing 0- 30 cm depth in 2010/2011 and 2011/2012 seasons.

Soil property	2010/2011	2011/2012
Particle size distribution		
Sand %	89.1	89.5
Silt%	4.7	4.9
Caly%	5.2	5.6
Texture grade	Sand	Sand
ECe (soil paste extract)dsm^{-1}	4.66	5.21
Ph (1;1 suspension)	7.99	8.14
$Caco_3$ %	8.21	7.96
Organic matter%	0.097	0.091
NaHco3- extractable p (ppm)	5.49	6.46
NaOCA – extractable(ppm)	61.52	52.46
Total nitrogen %	0.018	0.019
Kcl - extractable (ppm)	34.28	37.64
Dtpa - extractable Fe (ppm)	3.61	8.32
Dtpa - extractable Mn (ppm)	1.83	1.87
Dtpa - extractable Zn (ppm)	0.52	0.54
Dtpa - extractable Cu (ppm)	0.99	1.09
Hot water extractable B ppm	0.06	0.05

Each value represent the mean of 3 replicate

The source of nitrogen fertilizers were applied at two equal proportions. The first at thing .i.e. 45 day from sowing and second was at 75 days from sowing. All other culture practices were done as recommended. A sample of four plants from two replication from every treatment was chosen at random at 100,130 and 160 days from sowing to evaluate shoot root , fresh weight (g/plant), shoot and root dry weight , dry matter percentage of shoot and root % as a criteria of sugar beet plants growth. At harvest, a sample of ten plants from every treatment in three replication were chosen at random to study fresh and dry yield of shoots and roots as well as sugar yield of sugar beet. The chemical analysis was carried out in tops and roots during growth and harvest. The tops and root were separated, dried at 70˚ c for 3 day and 105˚c for two hours in air force draft oven, to determine their dry weight. Dry samples were ground and digested using mixture of concentrated. Sulfuric and perchloric acid and chemically analysis for total nitrogen according to kjeldahal method K and Na percentage were determined using flame photometer as well as Zn was determined in the digests using GBC model 300 atomic absorption spectrophotometer. Up take of N, K, Na and Zn was calculated by using multiplying the dry weight with the respective percentage of N, K, Na and Zn nutrient up take = nutrient conc. in root or top X root or top dry weight total soluble solids (TSS) in root juice determined using refract meter, sucrose continent was evaluated using sacchari meter apparatus by the methods of Le Docte (1927). Root juice purity %= sucrose X100/TSS. The data were exposed to proper statistical analysis of variance of complete randomized block design according to Snedecor and Cochran (1967) L.S.D at 5% level of significance was used to compare between means.

Results and Discussion

Growth criteria

Some growth parameters such as shoot fresh weight g/ plant, shoot dry weight, shoot dry matter percentage were evaluated periodically after 100,130 and 160 from sowing. The data in table (2) indicated that there were significant differences between nitrogen source on shoot dry weight g/plant in all ages except for 160 days insignificant in the second seasons the highest value of shoot dry weight g/plant produce when nitrogen source was applied as ammonium nitrate as well as ammonium nitrate as N source had significant effect on dry matter% at age 100 day from sowing this may be due to combined ammonium and nitrate fertilizers contain both the ammonium and nitrate ions. They thus have some of the same properties, both advantages and disadvantages of the ammonium and nitrate fertilizers. The nitrate nitrogen is readily available to plants for immediate use, whereas ammonium nitrogen becomes available to plants at a later stage, when it is transformed to nitrate by microbial processes in the soil. These fertilizers are soluble in water and suitable for use with most crops and soils. The commonly used straight fertilizers of this type are ammonium nitrate, ammonium sulphate nitrate and calcium ammonium nitrate Everaats, (1994) this results agree with El-Tantawy *et al.* (2009) he found that a significantly increased fresh Weight of beetroot leaves more (58.01 g) than ASN (45.46 g) and LAN (45.79 g).

Table 2: Response of sugar beet to nitrogen source at different growth stages during 2010/2011 – 2011/2012

Nitrogen source	Shoot fresh weight g/ plant		Shoot dray weight g/ plant		Shoot dray matter %	
	2010/11	2011/12	2010/11	2011/12	2010/11	2011/12
100 day from sowing						
Amm. sulphate	377	359	36.6	33.6	9.7	9.33
Urea	345	355	31	34	9.00	9.4
Amm. nitrate	373	372	37.3	36.6	9.93	9.83
LSD0.05	N.S	N.S	5.153	2.390	0.5902	0.389
130 day from sowing						
Amm. sulphate	405	423	40.0	42	9.8	9.8
Urea	451	491	44.6	52	9.9	10.6
Amm. nitrate	563	493	62.6	52	11.2	10.4
LSD0.05	107.9	N.S	5.125	4.207	N.S	N.S
160 day from sowing						
Amm. sulphate	482	481	53.6	51	11.1	10.6
Urea	485	505	49.3	59	10.1	10.9
Amm. nitrate	598	614	70.0	61	11.7	11.3
LSD0.05	N.S	N.S	17.75	N.S	N.S	N.S

Data in table (3) show gradual increase in root top/ ratio , root fresh weight (g/plant), root dry matter g/plant and root dry matter% as the growing progressive the root fresh weight and dry matter % were affected significantly by nitrogen sources in all ages in both seasons except 130and 160 day in the second season .while root top/ ratio were affected significantly at age 130 day only in both seasons and root dry weight at age of 130 and 160 day in the first season only . The height value in all cases obtained from using ammonium nitrate as nitrogen sources comparing with urea and ammonium sulphate the influence of nitrogen as ammonium nitrate on agronomic efficiency is mainly due to their effect on soil reaction and nutrient availability. This results are in a good line with those obtained by Nemeat (2001) reported that AN as a nitrogen source surpassed urea or ammonium sulphate in beetroot. Badawi (1996) also indicated that urea as foliar nutrition had an active role in enhancing growth and yield of beet.

Chemical composition and quality control:

The results in table (4) indicated no significant difference between means of nitrogen % in sugar beet roots in all different stages of growth by applying different nitrogen sources, while nitrogen % in sugar beet shoots significantly affected in most different stages of growth by applying different sources of N fertilizer. Generally it was a tendency for decreasing nitrogen % in shoots versus growth period. These results agree with those obtained by Smith *et al*. (1973) they found that nitrogen percentages of beetroot tops were increased by nitrogen fertilizer application. This concurs with the findings of Hellal *et al.* (2009) who reported that nitrogen application significantly increased nitrogen content in shoot and root of beetroot than those in the control plants. They also stated that the increment in nitrogen percentage may be due to fixed nitrogen fertilizers used as a nitrogen source.

Results obtained in table (4) point out the height values of nitrogen up take in shoots and roots due to application of N in form of ammonium nitrate followed by ammonium sulphate these results were true 100,130 and 160 days from sowing these results might be due to the favorable effect of ammonium nitrate and ammonium sulphate on dry matter accumulation in top and root.

Table 3: Response of sugar beet to nitrogen source at different growth stages during 2010/2011 – 2011/2012.

Nitrogen source	Root top /ratio		Root fresh weight g/ plant		Root dray weight g/ plant		Root dray matter%	
	2010/11	2011/12	2010/11	2011/12	2010/11	2011/12	2010/11	2011/12
100 day from sowing								
Amm. sulphate	1.47	1.54	291	283	54.00	51.66	18.46	18.16
Urea	1.61	1.54	277	285	49.66	53.66	18.06	18.70
Amm. nitrate	1.57	1.56	293	292	58.00	55.66	19.10	18.70
LSD 0.05	N.S	N.S	5.369	2.267	N.S	N.S	1.095	0.529
130 day from sowing								
Amm. sulphate	2.77	2.64	486	505	111	131	22.6	21.6
Urea	2.52	2.36	535	552	112	126	21.0	21.9
Amm. nitrate	2.22	2.49	622	555	139	122	22.8	22.3
LSD 0.05	0.3122	0.1567	81.467	38.623	16.778	N.S	1.3623	N.S
160 day from sowing								
Amm. sulphate	4.3	4.26	1057	1005	229	220	21.7	15.3
Urea	4.3	4.36	953	1133	211	243	22.1	22.8
Amm. nitrate	4.46	4.33	1271	1143	307	267	23.5	22.4
LSD 0.05	N.S	N.S	142.61	100.56	17.256	N.S	N.S	N.S

Table 4: Response of sugar beet top and root nutrient concentration (% dry matter) and their uptake to nitrogen source at different growth stages (Average of two seasons 2010/11/2011/2012)

Nitrogen source	Nitrogen %							
	Shoot		Root		Nitrogen up take			
					Shoot		Root	
100 day from sowing								
Amm. sulphate	4.0	4.1	1.78	1.83	1.46	1.35	0.96	0.94
Urea	3.8	4.0	1.87	2.07	1.15	1.27	0.92	1.27
Amm. nitrate	3.7	3.7	2.38	2.11	1.44	1.47	1.39	1.17
LSD 0.05	N.S	N.S	N.S	N.S	0.0979	0.0302	0.141	0.2065
130 day from sowing								
Amm. sulphate	3.8	3.7	1.29	1.71	1.56	1.56	1.47	1.44
Urea	3.5	3.4	1.34	1.81	1.57	1.89	1.41	1.66
Amm. nitrate	3.2	3.7	1.35	1.75	2.27	1.85	1.95	1.72
LSD 0.05	0.0721	N.S	N.S	N.S	0.6067	N.S	N.S	N.S
160 day from sowing								
Amm. sulphate	2.2	2.1	1.08	1.25	1.23	1.28	2.62	2.38
Urea	2.3	2.5	1.16	1.18	1.23	1.66	2.31	2.43
Amm. nitrate	2.9	2.5	0.83	1.15	2.15	1.80	2.56	2.50
LSD0.05	0.83	0.19	N.S	N.S	0.64	N.S	0.4371	N.S

Results in table (5) indicated significant difference between means of K % in sugar beet shoot and roots in most different stages of growth by application different sources of N fertilizer. These results disagree with Gabrie Rantao (2013) he found nitrogen source did not significantly influenced the potassium content. Plants that received LAN as nitrogen source higher potassium contents in the leaves (5.00%) than AN (4.42%), urea (4.30%) and UAN (4.01%). The lowest potassium content (4.01%) in the leaves was obtained when using UAN as a nitrogen source. The percentage of potassium was decrease in shoots at 130 days comparing to age 100 days followed by further increment reaching its maximum values after 160 days from sowing. Regarding the response of sugar beet plants to absorb and accumulate of K as plant physiologically aged, the results obtained in table (5) point out that the highest values of uptake for K in roots and shoots due to application of N in form of ammonium nitrate. Followed by urea these results were true at ages 100,130 and 160 days form sowing. generally , as the growth period advance towards maturity K uptake by sugar beet plants were increased in whole plant by applying ammonium nitrate as N source these results might be due to the favorable effect of ammonium nitrate on dry matter accumulation in root and top these results consistent with (Tisdale *et al*., 1995). He found Nitrogen nutrition promoting the total potassium content in cauliflower heads.

Results in table (6) indicated significant difference between means of Na % in sugar beet shoot and roots in most different stages of growth by application different sources of N fertilizer. The highest values obtained from application N as ammonium sulphate this results disagree with Gabrie Rantao (2013) he found nitrogen source did not significantly influenced the Na content. Regarding the response of sugar beet plants to absorb and accumulate of Na as plant physiologically aged, the results obtained in table (6) point out that the highest values of uptake for Na in roots and shoots due to application of N in form of ammonium nitrate. Followed by ammonium sulphate and urea these results were true at ages 100,130 and 160 days form sowing. generally, as the growth period advance towards maturity Na uptake by sugar beet plants were increased in whole plant by applying ammonium nitrate as N source these results agree with Gutstein (1968) reported that nitrogen fertilizer increased absorption of sodium and Marschner (1998) reported that nitrogen has a positive effect on sodium uptake and that the roots are the main sink of sodium.

Table 5: Response of sugar beet top and root nutrient concentration (% dry matter) and their uptake to nitrogen source at different growth stages (Average of two seasons 2010/11/2011/2012)

Nitrogen source	Potassium%							
	Shoot		Root		Potassium% up take mg / plant			
					Shoot		Root	
100 day from sowing								
Amm. sulphate	3.93	3.95	2.52	2.67	1.44	1.40	1.36	1.38
Urea	3.98	3.84	2.83	2.57	1.36	1.38	1.41	1.51
Amm. nitrate	3.74	3.84	2.80	2.66	1.30	1.41	1.64	1.49
LSD 0.05	0.0207	0.0334	0.0245	N.S	N.S	N.S	--------	--------
130 day from sowing								
Amm. sulphate	3.54	3.55	1.56	1.46	1.42	1.50	1.74	1.55
Urea	3.57	3.35	1.37	1.39	1.59	2.02	1.37	1.54
Amm. nitrate	3.16	3.36	1.35	1.42	1.98	1.69	1.88	1.7
LSD 0.05	N.S	0.219	0.037	N.S	0.037	N.S	0.1875	N.S
160 day from sowing								
Amm. sulphate	4.21	4.52	1.16	1.17	2.26	2.32	2.66	2.72
Urea	4.84	4.67	1.17	1.16	2.39	2.77	2.47	3.07
Amm. nitrate	4.51	4.36	1.17	1.17	3.16	2.71	3.61	3.09
LSD 0.05	0.12	0.06	0.05	N.S	N.S	N.S	0.24	N.S

Table 6: Response of sugar beet shoot and root sodium content mg / 100 g dry matter) and their uptake to nitrogen source at different growth stages (Average of two seasons 2010/11/2011/2012)

Nitrogen source	Sodium %							
	Shoot		Root		Sodium % up take mg / plant			
					Shoot		Root	
100 day from sowing								
Amm. sulphate	6.25	6.22	1.20	1.22	2.29	2.16	0.66	0.62
Urea	5.93	6.07	1.01	1.19	2.04	2.33	0.59	0.54
Amm. nitrate	5.89	6.02	1.05	0.84	2.20	2.41	0.48	0.56
LSD 0.05	0.03	N.S	0.05	0.08	N.S	N.S	0.1335	N.S
130 day from sowing								
Amm. sulphate	5.94	5.69	0.74	0.83	1.00	0.93	0.96	0.93
Urea	5.45	5.39	0.93	0.85	1.05	1.07	1.00	0.96
Amm. nitrate	5.33	5.63	0.78	0.77	1.09	0.95	1.05	1.03
LSD 0.05	0.067	0.034	0.09	N.S	N.S	0.05	1.19	0.92
160 day from sowing								
Amm. sulphate	5.66	5.46	0.87	0.79	3.04	2.81	1.96	1.76
Urea	5.23	5.10	0.74	0.73	2.58	3.04	1.56	1.91
Amm. nitrate	5.04	5.34	0.74	0.79	3.56	3.30	2.26	2.11
LSD 0.05	0.08	N.S	N.S	0.02	N.S	N.S	0.15	0.07

Results in table (7) indicated significant difference between means of boron % in sugar beet shoot and roots in most different stages of growth by application different sources of N fertilizer. Using NH4 NO3 fertilizer promotes the roots to absorb more available B from soil. Whereas, NH4S04 fertilizer inhibited this characters to its minimal value the highest values obtained from application N as urea followed by ammonium sulphate results obtained in table (7) point out that the highest values of uptake for boron in roots and shoots due to application of N in form of ammonium nitrate and urea .

Results in table (8) indicated significant difference between means of zinc % in sugar beet shoot and roots in most different stages of growth by application different sources of N fertilizer. the highest values obtained from application N as ammonium sulphate followed by ammonium nitrate these results agree with Marshner (1998) reported that the higher contents of zinc recorded for beetroot leaves, under nitrogen fertilization, was expected because of the positive effect of nitrogen application in increasing the zinc content, as well as the fact that leaves are the main sink for zinc. Results obtained in table (8) point out that the highest values of uptake for Zinc in roots and shoots due to application of N in form of ammonium nitrate and urea.

Data in table (9) showed that the nitrogen fertilizer sources insignificant effect on sucrose %, T.S.S and purity percentage in all growth stages except 100 and 130 day in the first season for sucrose and 1oo day for T.S.S in the first season only while purity were significant at age 160 day in second season only the highest value in all pervious characters obtained from using nitrogen in form ammonium nitrate (33.5) the influence of nitrogen fertilizer as ammonium nitrate on agronomic efficiency is mainly due to their effect on soil reaction and nutrient availability these results are in good agreement with those reported by Saif (1991), Nemeat *et al.* (1997) and (2001) and Sharief *et al*. (2004).

Table 7: Response of sugar beet shoot and root boron content mg / 100 g dry matter) and their uptake to nitrogen source at different growth stages (Average of two seasons 2010/11/2011/2012)

Nitrogen source	Boron content (ppm)							
	Shoot		Root		Boron up take mg / plant			
					Shoot		Root	
100 day from sowing								
Amm. sulphate	37.6	38.6	13.3	19.3	1.42	1.34	0.72	1.00
Urea	38.6	37.3	25.6	23.0	1.28	1.41	1.27	1.14
Amm. nitrate	38.6	39.3	20.6	17.0	1.48	1.41	1.19	1.04
LSD 0.05	1.19	N.S	0.15	N.S	2.38	1.51	N.S	
130 day from sowing								
Amm. sulphate	34.66	33.33	12.33	16.00	1.39	1.42	1.37	1.83
Urea	32.66	37.66	20.33	18.00	1.45	1.78	2.30	2.23
Amm. nitrate	43.00	39.00	15.66	15.33	2.68	2.05	2.17	1.77
LSD 0.05	0.3183	N.S	0.4129	0.2126	2.7245	N.S	0.9212	
160 day from sowing								
Amm. sulphate	38.00	42.66	19.00	21.66	2.03	2.19	4.30	4.78
Urea	48.33	45.33	25.00	24.00	2.37	2.71	5.25	5.78
Amm. nitrate	43.00	40.33	23.00	20.66	3.06	2.54	7.02	5.65
LSD 0.05	4.50	2.38	1.30	0.75	N.S	N.S	0.58	0.53

Table 8: Response of sugar beet shoot and root zinc content mg / 100 g dry matter) and their uptake to nitrogen source at different growth stages (Average of two seasons 2010/11/2011/2012)

Nitrogen source	Zinc(ppm) %							
	Shoot		Root		Zinc up take mg / plant			
					Shoot		Root	
100 day from sowing								
Amm. sulphate	16.0	16.0	11.0	12.3	0.59	0.52	0.59	0.51
Urea	12.6	12.6	14.0	14.6	0.69	0.81	0.43	0.47
Amm. nitrate	13.6	13.7	16.3	14.3	0.94	0.77	0.51	0.54
LSD 0.05	2.5625	2.5625	3.2938	1.5113	0.2915	N.S	N.S	N.S
130 day from sowing								
Amm. sulphate	18.3	17.0	11.3	15.3	1.26	1.72	0.74	0.73
Urea	14.6	17.3	19.3	14.3	2.18	1.80	0.72	1.01
Amm. nitrate	20.6	20.0	10.3	10.3	1.43	1.34	1.30	1.02
LSD 0.05	4.6887	1.3088	0.4424	0.211	0.5668	0.2841	0.3619	0.1853
160 day from sowing								
Amm. sulphate	13.0	11.6	21.0	20.3	4.7	4.2	0.71	0.65
Urea	11.6	10.6	20.6	20.0	4.3	5.2	0.54	0.68
Amm. nitrate	11.0	12.6	20.0	20.0	6.0	5.4	0.82	0.75
LSD 0.05	1.51	1.51	N.S	N.S	0.15	0.05	N.S	0.49

Table 9: Response of sugar beet juice quality to nitrogen sources at different growth stages and during 2010/2011/2011/2012 seasons

Nitrogen source	Sucrose %		T.S.S%		Purity %	
	2010/11	2011/12	2010/11	2011/12	2010/11	2011/12
100 day from sowing						
Amm. sulphate	11.5	11.1	16.5	16.7	70	67
Urea	10.7	11.4	16.7	16.7	64	67
Amm. nitrate	11.8	11.4	17.1	16.9	69	68
LSD 0.05	0.7086	N.S	0.537	N.S	N.S	N.S
130 day from sowing						
Amm. sulphate	12.7	14.2	18.1	18.6	71	74
Urea	14.9	14.3	19.3	19.1	77	75
Amm. nitrate	15.2	13.9	19.4	18.8	75	73
LSD 0.05	0.9528	N.S	N.S	N.S	N.S	N.S
160 day from sowing						
Amm. sulphate	15.8	15.5	20.8	20.4	76	75
Urea	15.1	16.0	20.4	20.4	74	76
Amm nitrate	16.9	16.3	21.2	20.9	80	78
LSD 0.05	N.S	N.S	N.S	N.S	N.S	1.9993

Effect of nitrogen sources on macro and micronutrients at harvest

Regarding the response of sugar beet plants to absorb and accumulate of Na as plant physiologically aged, the results obtained in table (10) point out that the effect of nitrogen sources were significant differences for N and K up take at harvest the highest value for N uptake g/ plant and kg/ fed obtained from using N sources as form ammonium sulphate in both seasons except the first season for N uptake g/ plant from using ammonium nitrate this may be due to the highest value in table (4) for nitrogen uptake at different stages obtained from using N fertilizer on form of ammonium nitrate followed by ammonium sulphate consequently increase N uptake at harvest. while potassium up take were significant affected by N sources at harvest in both seasons for K up take kg/fed the highest value in the first season obtained from using nitrogen fertilizer in the form of urea while in the second season from ammonium nitrate these results agree with those obtained by Gutstein (1967) he found that nitrogen fertilizer played decisive role in the uptake of other nutrient elements it increased considerably the absorption of soil and fertilizer potassium and sodium . The results obtained in table (11) point out that the effect of nitrogen sources were significant differences for Na up take at harvest the highest value for Na uptake %, g/ plant and kg/ fed obtained from using N sources as form ammonium sulphate in both seasons except Na uptake kg/fe in the first season obtained from ammonium nitrate these results consistent with Marschner (1988) he found Nitrogen fertilization significantly increased sodium percent in the second season. While nitrogen sources not significant effect on Boron up take % and g/ plant at harvest except Born uptake kg/fed was significant in both seasons the highest values obtained from using nitrogen fertilizer in the form of ammonium nitrate .regarding of Zinc uptake ppm ,g /plant and kg/fed .

Table 10: Response of sugar beet root macro (% dry matter) micronutrient s(ppm) and their uptake to nitrogen source at harvest During average the two seasons 2010/11/2011/2012.

Nitrogen source	Nitrogen up take						Potassium up take					
	%		g/plant		Kg/fed.		%		g/plant		Kg/fed.	
Amm. sulphate	0.60	0.61	1.88	1.96	34.26	35.76	1.58	1.12	3.41	3.57	62.24	65.86
Urea	0.55	0.61	1.87	1.81	32.60	32.86	1.27	1.09	3.43	3.17	66.72	58.62
Amm. nitrate	0.55	0.50	1.93	1.93	32.83	31.16	1.29	1.13	3.62	3.79	65.22	69.92
LSD 0.05	N.S	N.S	0.26	2.54	2.99	0.009	N.S	N.S	N.S	N.S	10.75	0.007

Table 11: Response of sugar beet root macro (% dry matter) micronutrient (ppm) and their uptake to nitrogen source at harvest during and average the two seasons 2010/11/2011/2012.

Nitrogen source	Sodium at harvest up take						Boron at harvest up take						Zinic up take at harvest					
	%		g/plant		Kg/fed		%		g/plant		Kg/fed		ppm		g/plant		Kg/fed	
Amm. sulphate	0.90	0.94	3.12	3.06	50.8	55.4	17.6	15.0	5.4	4.74	99.4	88.03	15.0	12.0	5.94	3.82	89.92	70.5
Urea	0.85	0.86	2.83	2.52	49.3	46.5	20.6	20.6	6.2	6.01	110.5	110.8	16.6	18.6	6.24	5.44	112.0	100.2
Amm. nitrate	0.89	0.85	2.82	2.83	53.7	52.1	18.0	21.3	6.4	7.20	121.9	133.0	19.6	21.6	5.56	7.31	107.7	134.6
LSD 0.05	0.03	N.S	0.33	3.15	6.41	2.38	N.S	N.S	N.S	N.S	40.30	2.2	4.7	N.S	2.12	N.S	37.12	N.S

Effect of nitrogen sources on yield and its components:

Data in table (12) point out nitrogen sources highly significant effected on root yield (ton/ fed), shoot yield (ton/fed), sugar yield (ton/fed) and sucrose % at harvest in both seasons. the maximum values of root yield(ton/ fed) , shoot yield (ton/fed), sugar yield (ton/fed) and sucrose % at harvest in both seasons were produced when nitrogen fertilizer was applied as ammonium nitrate (33.5%N) compared with other nitrogen sources The increase in top and root yield owing application nitrogen fertilizer as form of ammonium nitrate may be due to increasing boron and zinc concentrations data in table (7,8 and 11), which play as coenzymes and increasing the assimilates in which reflected on growth of leaves and root and increased dry matter accumulated in root and consequently increased top and root yields per faddan These results are in agreement with those obtained by Abd El-Hadi *et al.* (2002), Sharif *et al.* (2004) and Ouda (2006). Data in table (13) showed that nitrogen sources not significantly affected fresh root (g/plant), dry root(g/plant), Dry matter (g/plant) and dry root(ton /fed) except dry root(ton /fed) were significant in the first season only the highest value obtained from using nitrogen fertilizer in the form of ammonium nitrate this may be due to ammonium nitrate increase boron and zinc concentration data in table (7 and 8) which play as coenzymes and increasing the assimilates in which reflected on growth of leaves and root and increased dry matter accumulated in root . These results are in agreement with those obtained by Abd El-Hadi *et al.* (2002), sharif *et al.* and Ouda (2006).

Table 12: Response of sugar beet yield (ton/fed) and sucrose % to nitrogen sources at harvest during and average the two seasons

Nitrogen source	Root yield (ton /fed)		Shoot yield (ton /fed)		Sugar yield (ton /fed)		sucrose % at harvest	
	2010/11	2011/12	2010/11	2011/12	2010/11	2011/12	2010/2011	2011/2012
Amm sulphate	22.56	23.80	6.3	5.84	3.64	3.62	16.13	15.5
Urea	23.36	24.50	6.53	5.34	3.90	3.67	16.3	16.77
Amm nitrate	24.13	24.53	6.60	6.15	3.93	4.24	16.88	17.08
L.S.D 0.05	1.32	0.10	0.15	0.54	0.18	0.28	0.90	0.22

Table 13: Response of fresh root, dry root weight (g/plant), dry root weight (tons /fed.) and dry matter (tons /fed.) nitrogen sources at harvest during average the two seasons

Nitrogen source	Fresh root (g/plant)		Dry root (g/plant)		Dry root ((ton /fed)		Dry matter (ton/fed)	
	2010/11	2011/12	2010/11	2011/12	2010/11	2011/12	2010/11	2011/12
Amm sulphate	1278	1292	302	316	5.60	6.43	23.80	23.03
Urea	1334	1265	316	289	5.74	6.26	24.50	23.13
Amm nitrate	1348	1404	314	328	5.99	6.76	24.53	22.03
L.S.D 0.05	N.S	N.S	N.S	N.S	0.56	N.S	N.S	N.S

Conclusion

It could be conclude that maximizing results in the most of growth parameters such as fresh weight and dry weight of shoots and roots also, root yield per feddan and quality by using ammonium nitrate (33.5%) follow by urea (46%) as a source of nitrogen fertilizer under environmental condition of Assiut Governorate.

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